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THE ROYAL ACADEMY.

TO the lovers of the old-fashioned style of landscapes, with subdued mahogany as the prevailing tint, few paintings in this year's exhibition will be more charming than Mr. Leader's "Morning: the Banks of the Ivy, O!" No. 550, Gallery VI. The painting is, in fact, very pleasing, but it is not often that these tints are seen in nature. Certain French, Flemish, and Dutch painters affect them, and we presume they must have seen them; we have not been so fortunate ourselves. Facing this picture is one which will grievously offend all those who think that art should set the fashion to nature, Mr. Charles Stuart's "Sunny Autumn," No. 627. We have seldom seen finer and less exaggerated light than there is in this really charming picture. We have not a blaze of light in which all details are lost, as in so many of Turner's landscapes, nor have we staring contrasts, but a gentle light seems to shine through the landscape. The tender autumn glow is rendered perfectly. Certain optical effects are erroneously presented, however. The vertical reflections (very faint, it is true) in the water, do not correspond to any feature in the landscape which in nature would cast such reflections. At an earlier or later time than that shown in the painting, when the shadows were more marked, they may have been seen, but not otherwise. However, this painting is really so beautiful that we feel loth to touch on what is, after all, a very trivial fault. No. 557, "Winter and Rough Weather," by Mr. Moore, seems intended as a parody on Turner at his wildest. In passing, we notice again a picture in the same room to which we have already referred,—"Extremes Meet," by Mr. Alfred Strutt—to explain that when we spoke of incorrect drawing, we referred not to the dogs but to the background. Considered apart from the background, the big fellow is a very fine dog, and the little "toy" beside him only duly small: but, considered with reference to the background, both dogs look smaller than they should be.

We must notice some of the portraits in the galleries of painting and of sculpture. But we are told that there is a great pressure on space this week, so we leave this to another occasion.

We may, in passing, consider some of the water-colour paintings. "The Dying Day," by Walter E. Stocks, is very finely painted, the effects of the dying lights being well caught. Miss Kate Macaulay, in "Scotch Herring Trawlers," No. 894, and "A Sea Cliff," No. 914, represents a very curious substance, on which boats are placed as they might be placed on the sea; but it is not sea—nor have we any idea what it is—it is like nothing we have ever seen outside this lady's paintings. Mr. Arthur Croft, in Nos. 902 and 906—the latter a magnificent painting—has admirably dealt with the difficulties involved in the correct delineation of misty air in water-colours; while in the "Port of Algiers, Africa," No. 917, he as skilfully represents the effects of an exceptionally pure atmosphere. In No. 1,056, "Hill-side at Assisi," Mr. Henry Goodwin tries to represent a rainbow! "Coneysthorpe," No. 1,062, by Mr. Walter F. Stocks (it was hardly necessary to add to our last sentence that Mr. Goodwin utterly fails in representing a rainbow), is a painting in the old-fashioned style, but very charming, too. We must ask Mr. Proctor about the moons in Nos. 1,094 and 1,099. The horned moon in the latter, "An August Evening," by Mr. Walter F. Stocks, is certainly unlike the horned moon as we have ever seen it on an evening when the air is so pure,—the horns being fluffy in a clear sky. But can the line joining the horns of the setting moon in autumn be nearly upright? we always thought that they were at right angles to a line from the sun. [So they are. We have seen both this moon and the moon in "Cairo from the Mohattam Hills," by Tristram Ellis (No. 1,094), (gibbous near the place of sunrise at early morning), and both are, in an astronomical sense, utterly wrong. Of the artistic qualities of either painting we would not venture, of course, to express an opinion. But we can see no earthly, or heavenly, reason why the heavenly bodies should not be correctly represented in paintings,—even by Royal Academicians. Is there anything inartistic in correctness? On the cover of the two first thousand of our "Easy Star Lessons" there was a sort of parody on Orion, and we were told, when we remarked on its utter inaccuracy, that it was meant to be artistic. Is the real Orion of the skies unfortunately inartistic? We note that in the painting of "The Saving of the Capitol"—we have not our artist by us to tell us the number and painter, and the printers are waiting—there is a sort of attempt to represent certain familiar star-groups; but the painter seems to have been afraid lest there might be something inartistic in putting in the stars as they exist in reality (or, it occurs to us as possible, he may think they have altered since the time of ancient Rome). It would be as artistic, I should say, to represent limbs and muscles incorrectly as the stars which garland the heavens. There is nothing essentially artistic in incorrectness.—ED.]

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

BY AMELIA B. EDWARDS.

I.—THE ARGUMENT OF DE ROUGÉ.

THE busy, practical world does not, as a rule, concern itself very warmly in matters of archæological research, and rarely indeed has any discovery of a purely archæological character taken so powerful a hold upon the attention of the general public as did the recent discovery at Thebes. The first announcement of the decipherment of the Deluge Tablets by the late George Smith can alone be compared with it in this respect; but the

enthusiasm with which that announcement was received neither spread so fast nor rose so high as the excitement with which, in the month of July, 1881, we read of the finding of Rameses the Great. For, although the mortal remains and sepulchral relics of between thirty and forty royal personages belonging to various dynasties had, it was reported, been recovered from the depths of a subterraneous tomb at Dayr-el-Baharee, and although some others of those mummied kings were among the mightiest warriors of ancient Egyptian history, it was upon the mummy of Rameses the Great, the reputed oppressor of the Hebrews, that our interest was mainly concentrated.

I say the "reputed" oppressor, because, in the absence of direct contemporary evidence, it is scarcely possible to prove quite positively that Rameses II. was indeed the Pharaoh who afflicted the descendants of Jacob. That is to say, no Egyptian records bearing upon the history of the Hebrew sojourn, or even mentioning the Hebrews by name,* have yet been discovered. Nor is this to be wondered at; for, in the first place, that part of Egypt in which the Hebrew colony dwelt—namely, the land of Goshen—remains to this day almost wholly unexplored; and, in the second place, being themselves politically insignificant, the Hebrews were not likely to be named in monumental inscriptions elsewhere. We have, therefore, no contemporary evidence, except the evidence of the Book of Exodus, upon which to found an inquiry; and the Book of Exodus, although it refers to two successive Pharaohs, unfortunately omits to give the name of either. If we turn from the Book of Exodus to the Book of Genesis, the same unaccountable omission confronts us in the histories of Abraham and Joseph. The king who entreated Abraham well for Sarah's sake, and the king who set Joseph over all the land of Egypt, are alike anonymous. In all four instances, the foreign ruler is called simply "Pharaoh," or "king." It is therefore only by means of a very strict analysis of the text that we are enabled to arrive at any conclusion regarding the historical epoch at which Abraham journeyed into Egypt, or Joseph rose to power, or the Hebrews suffered oppression and fled from captivity. There is, of course, but one way in which to conduct an analysis of the kind; that way being carefully to note every precise statement and every incidental allusion contained in the Hebrew narrative, and to collate such statements and allusions with cognate statements and allusions derived from Egyptian sources "Cognate," be it observed; not "identical." We have always to bear in mind that Egyptian documents are silent as to the Hebrews from first to last; and that, for the purposes of this inquiry, such documents are available only as they enable the analyst to calculate probabilities of time and place, to identify localities, and to interpret those touches of local colour in which the Bible-narrative abounds. Above all, it must be remembered that but for the Bible we should know nothing whatever of the Hebrews in Egypt, nor of their final settlement in the Land of Canaan. For these important events the Bible is our sole authority. Its information is invaluable, as far as it goes; but it does not go far enough. The stories of Abraham and Joseph, though told at some length, leave untold the very facts which would have determined their place in history; while the period of the oppression, which must have extended over several reigns, is dismissed in the briefest manner, and is so vaguely worded that it reads as if all happened under the rule of a single Pharaoh. These are the missing links which puzzle Bible students and baffle archæological inquirers. We may hope here and there to bridge over a chasm or fill up a blank; but it is impossible absolutely to re-establish the chain of events from Egyptian sources, so long as the cities and cemeteries of the Land of Goshen lie buried under enormous rubbish-mounds, which, in a corrupt but recognisable form, preserve to this day the ancient names of the sites upon which they have risen.

I may at once premise that Egyptologists are, for the most part, agreed in identifying the Pharaoh of the Oppression with Rameses II., and the Pharaoh of the Exodus with his son and successor, Menephthah I. This identification—originally proposed by the late illustrious Vicomte E. de Rougé—has undoubtedly more probabilities in its favour than any other. I will even say that it has, I venture to think, even more probabilities in its favour than have as yet been recognised; and that some of these unrecognised probabilities are so conclusive that they very nearly amount to proof. Before, however, we proceed to an analytical examination of the evidence which connects this Pharaoh with the period of the oppression, it will be well to give a general outline of the argument, and for this purpose I cannot do better than translate the following passage from M. de Rougé's preface to his "Notice Sommaire" of the Egyptian antiquities in the Louvre collection:—

"The chronology of Egyptian history and the chronology of the Bible (especially when it becomes a question of estimating the period of the Judges) is altogether too full of uncertainties to enable us, *à priori*, and by a simple comparison of dates, to determine under which king the Exodus took place. The difficulty is even greater as regards the time of the patriarch Joseph, because the length of time during which the captivity lasted is in itself a fruitful subject of controversy. Moses never employs any but the generic term 'Pharaoh,' which means 'the King.' But if we carefully note the salient points of the Bible narrative, we find, first of all, a king who compelled his slaves to build the city of Rameses, in Lower Egypt. Next, if we calculate the time during which Moses dwelt with Jethro, when he fled from the wrath of the king; if we remember that Moses smote the Egyptian just as he had attained to manhood, and that, according to the Bible, he was eighty years old at the time of the Exodus, it will at once be seen that the reign thus indicated must have been excessively long. The Bible says, in fact, 'After a long time, the king died.' But one Rameses answers to all these particulars—namely, Rameses II., who reigned for 67 years, and who did actually build a city in Lower Egypt, to which he gave his name. Moses came back from Arabia as soon as he heard of the death of the king whom he had angered. The Bible account of the plagues of Egypt, and of the horrible catastrophe which attended the departure of the Israelites, would seem to be compatible with only a limited number of years. Menephthah, son of Rameses II., is, without doubt, the Pharaoh of the Red Sea; but the Mosaic narrative does not give us to understand that the

* M. Chabas, an eminently learned and cautious Egyptologist, published an article nearly twenty years ago in his first series of "Mélanges Egyptologiques," wherein he sought to identify the Hebrews with a class of workmen called in Egyptian the *Aperiu*, who were employed to extract stone from the quarries opposite Memphis during the reign of Rameses II. These *Aperiu* are twice mentioned in the reports of certain overseers of the works named Kauiser and Keniamon, which reports, written on papyrus in the Hieratic character, are among the treasures of the Leyden Museum. Unfortunately for M. Chabas's argument, however, a strict comparative examination of numerous Hebrew words imported into the Egyptian language shows that the Egyptians rendered the Hebrew *b* by a combination equivalent to *vp*, and not by *p*, as in *Aperiu*; while the latest researches show the *Aperiu* to be an Egyptian tribe of whom mention is made, according to Lenormant, as early as the VIth Dynasty. See Lenormant's "Histoire Ancienne de l'Orient," vol. ii., p. 271. 1882.

king himself was among the victims of this disaster. He would seem, in fact, to have reigned for nineteen years; and perhaps a less interval of time than nineteen years may have elapsed between the return of Moses and the passage of the Red Sea. No trace of these earliest relations of the Israelites with the land of Egypt has been found upon the monuments; and it would, indeed, be extraordinary if the Egyptians had recorded this disaster in their temple-sculptures, which never commemorated any military events except victories."

THE SEASIDE HEALTH RESORTS OF ENGLAND.

By ALFRED HAVILAND.

INTRODUCTION.

IT is proposed to publish in this magazine a series of short papers on those seaside towns to which people usually resort, with the view not only of interesting them about such places, but of guiding them in the selection of the most appropriate to meet their peculiar health requirements.

Hitherto, accident, popular caprice, convenience, or fashion have contributed principally, either collectively or singly, in rendering many places famous as health resorts. Some, however, have had their fame based upon more solid foundations, viz., upon the experience of learned and practical physicians, who, after studying diseases generally in relation to the various factors which constitute *climate*, have sought out the causes which influence their prevalence or scarcity, and have thus been enabled to recommend certain localities for the cure or alleviation of the diseases of their patients.

Hippocrates, 500 years before the Christian era, taught this mode of investigation, especially in his immortal work on "Airs, Places, and Waters," and it would have been well had his teachings been more treasured and acted upon by his successors during the last 2,000 years than they have been. However, during the last five-and-thirty years there have been accumulated such a vast number of returns of deaths from disease, that at last it has become possible to map them in such a manner as to show at a glance throughout England and Wales where are to be found the favourite haunts of those causes of death which characterise this country's mortuary returns. On the other hand, the same map will show where these fatal causes *do* not or *cannot* thrive. Hence we have, on a grand scale, health-guides as regards certain classes of diseases, and we shall see in the sequel that, by a study of the principal factors of the local climate of any place, we gain a clue to the kind of diseases that would either prevail or languish there. On the other hand, a map showing the distribution of certain diseases will give us an insight into the physical geography and climate of the localities where they abound, or are rare. For instance, a map pourtraying the geographical distribution of rheumatism and heart disease will, at a glance, show the sites of all the closed valleys of England and Wales, for it has been proved that these causes of death are to be found in the greatest abundance, without exception, in all those districts where the valley systems are so formed as to preclude the possibility of their being air-flushed by the prevailing winds. Again, a map showing the distribution of consumption will have defined on it, in unmistakable groups, not only those localities where social causes foster it, but where the native populations cannot, when inheriting this terrible lung trouble, withstand the full unchecked force of the prevailing winds. Such a map has all its exposed localities defined by the colouring of the high mortality degrees. One more illustration will suffice to prove our proposition that the physical and climatic features of a country may be predicted by a knowledge of its typical diseases. The remarkable distribution of cancer in females throughout England and Wales points out, by the colouring of the high mortality riparial districts, the courses of all the rivers in England and Wales that seasonably overflow their banks after wet seasons.

Now, all this information, however interesting it may be, would, after a time, cease to be so, were it not capable of being applied to our daily use.

A knowledge of how different diseases are distributed the great registration divisions of our country, its counties, and six hundred and thirty districts, teach us lessons and principles which would be valueless if not applicable to our towns, villages, and dwellings.

The distribution of heart disease and rheumatism teaches us a grand lesson in ventilation; it points out to us the true mode of street arrangement so as to offer every facility for thorough air flushing; it warns the invalid when seeking a health resort to avoid such as abound in gridiron clusters of streets, where diseases of the infectious class have their stronghold, simply because such a street arrangement precludes thorough flushing of the air sewage. It teaches also those subject to or recovering from rheumatism or rheumatic heart disease, to avoid pent up valleys, however lovely, where the benign influence of the sea winds is shut out. The lesson taught by the distribution of consumption must be remembered by those labouring under this lung trouble; they must not heedlessly select a health resort, for some there are which foster this disease, and even those which have a fair reputation for its prevention or alleviation, may have sites within their boundaries quite unsuitable for consumptive cases. Health resorts, especially those by the sea, are often selected, and, in many cases, very properly so, by masters and mistresses of schools for their establishments. Although at first it appears natural that a seaside health resort would be an eligible place for a school, yet we shall be able to show in the following series, that great precautions will have to be taken by those having the natural charge of children and young persons, before they send them away from home to be educated even at health resorts.

We must remember that the period of education is the period of developmental life, and that whenever there are hereditary taints in the young blood, whether of cancer, consumption, rheumatism, &c., that such places should be avoided during the scholar and student life that are known to be favourable to the development of any of these and similar diseases.

We shall endeavour, in the papers which will follow on the Sea-side Health Resorts of England, so to treat the physical geography, geology, climate, and vital statistics of each, as not only to interest the general reader, but clearly to explain the simple principles which should guide the health-seeker in the selection of a health resort.

POPULATION OF THE EARTH.

A CORRESPONDENT (Mr. H. Percival) sends us the following question:—

The land surface of the earth comprises 52,000,000 *square miles. The most densely populated region (East Flanders) has a population of about* 700 *to the square mile. If the whole land surface of the earth were on the average as densely*

XUM

peopled, the earth's population would be 36,400,000,000. *Assuming the present population to be* 1,500,000,000, *and supposing it henceforth to increase at the rate of* 1½ *per cent. per annum, how many years would elapse before the earth's population would reach this number*—i.e. 700 *to the square mile of land?*

The population increasing in the ratio of 1015 to 1000 each year, if n be the required number of years, we have the following relation:—

$$(1{,}500{,}000{,}000)\left(\frac{1015}{1000}\right)^n = 36{,}400{,}000{,}000$$

$$\text{or } 15(1{\cdot}015)^n = 364$$

Taking logarithms of both sides, we have—

$$n \log.\ (1{\cdot}015) = \log.\ 364 - \log.\ 15$$

$$\text{or } n(0{\cdot}0064660) = 2{\cdot}5611014 - 1{\cdot}1760913$$

$$\text{or } n = \frac{13850101}{64660}$$

$$= 214{\cdot}1 \text{ years very nearly.}$$

Here is another curious question. Supposing the population of England and Wales to increase at the rate of 1½ per cent. per annum, and not to be affected by emigration, how long would it be before the population would increase from 26,000,000 till there would be one person to the square yard, or, roughly, 10,000 times as many persons as there are at present? To determine this, we have, taking n for the number of years,

$$\left(\frac{1015}{1000}\right)^n = 10000$$

$$\text{Or,} \quad n \log.\ (1{\cdot}015) = 4$$

$$\text{Whence} \quad n = \frac{4000000}{6466} = 619 \text{ years nearly.}$$

So that, apart from emigration, war, plague, pestilence, or famine, the population of England and Wales, six centuries hence, would be one to the square yard.

In a quarter of the above time, say in 154 years, the population of England, apart from such causes, would be ten times as great as at present, or there would be about 4,500, instead of about 450 to the square mile.

OUR ANCESTORS.

IV.—THE FINAL MIXTURE.

BY GRANT ALLEN.

AFTER the English settlement in south-eastern Britain, two other ethnical elements of less importance were added at different times to the population of our islands. Both were originally Scandinavian (and therefore Aryan) by descent, but more or less mixed with other strains from elsewhere. The first was that of the heathen Scandinavians from the north. In the eighth and ninth centuries, large bodies of Danes and Northmen began to settle all round the coasts of Britain. In Ireland they occupied all the large river mouths and havens, such as Dublin, Wexford, Waterford, and Cork, where they formed a set of Scandinavian colonies which gradually coalesced with the native Celt-Euskarian population. In Scotland they seized upon Caithness, Sutherland, and Ross, on the mainland, together with Orkney, Shetland, and the whole of the Western Isles, from Lewis to Arran. In Wales they founded a few minor settlements around the south-west coast, near Milford Haven. Finally, in England itself, they occupied all Northumbria (including our Yorkshire), all Lincolnshire, Norfolk and Suffolk, and the greater part of the midlands. Important Danish "hosts" had their centres at Derby, Leicester, Nottingham, Huntingdon, Northampton, and Bedford. Norwegians also settled in the Lake District, till then peopled exclusively by the Strathclyde Welsh. How large an element in the population these Scandinavian invaders formed it would, perhaps, be difficult to estimate; but they must certainly have made a great accession to the number of light and fair-haired Aryan colonists. At the same time, since they came as mere pirates, they did not bring their women with them; and they therefore intermarried with the people of each district where they settled. Nor did they at all exterminate the earlier inhabitants. In Ireland their blood was thus almost lost in the prevalent Celt-Euskarian type; in the Lake district and the Scotch Highlands it has hardly had much more permanent influence; but in Eastern England, where the Scandinavians intermixed with the purest Aryan stock left in Britain, they must have afforded a very considerable reinforcement to the light type, and their fair hair has certainly left its mark upon a large part of the population.

The second Scandinavian admixture came later and more indirectly with the Normans from Normandy under William the Conqueror. These Normans were originally Danes like those who colonised eastern England; but they had intermarried with the native women of Neustria (northern France), where they settled; and the Neustrians were, of course, Celtic Gauls, largely intermixed with Euskarian elements. Moreover, the Conquest brought over, not these half breed Normans alone, but many pure Celt-Euskarian Gauls or Frenchmen from the neighbouring provinces as well, together with a considerable sprinkling of pure Celt-Euskarian Bretons from Brittany—a very dark stock, like the Black Celts of Ireland and Scotland. Accordingly, so far as numerical preponderance of the dark and light races goes, the Norman Conquest left things in Britain pretty much where they were before.

Thus, then, to sum up the general result of this brief inquiry, we may say that the ethnical composition of modern Britain is somewhat after the following fashion. First, there is a substratum or oldest stage of dark, non-Aryan people, whom we call Euskarians for convenience, and who are the descendants of the very earliest aboriginal inhabitants in recent times, the Neolithic folk. These Euskarians are now nowhere to be found in very great purity, for they have married in with the later Aryan invaders till both are at present well-nigh indistinguishable. But they are still found in a fairly unmixed form among the Black Celts of Ireland and Scotland, where one or two little communities yet remain almost unaltered in the wilds of Connaught or the highlands of the central Scotch hills. They are also more sparsely recognisable in many parts of England itself, especially in the Yorkshire plain, in Lincolnshire, and along the Severn valley. And they are fairly frequent in Wild Wales. All over the country, too, persons or families of this dark early type occur here and there sporadically. Indeed, it is probable that some relics of Euskarian blood survive everywhere in Britain, and that every one of us is more or less remotely descended on one side or the other from neolithic ancestors. Dark children of true Euskarian type are liable to be born from time to time in almost all families. It may be well to add also, in a science which is so personal to most of us as ethnology, that there is absolutely no sufficient proof that any one type or race in Britain is mentally or morally superior to any other. We must not fall into the easy habit of supposing that an earlier race is necessarily either a better or a worse one: the facts do not go to prove either supposition.

Secondly, there is a superstratum or later stage of light Aryan people, who have broken over the islands in three distinct waves—Celtic, English, and Scandinavian, and

have everywhere mixed more or less with one another, and with the old Euskarian race. Ireland is, perhaps, mainly peopled by Euskarians, intermixed, in most parts, with Celts (but least so in Connemara and Kerry), while round its east coast there is much Scandinavian blood; and in Ulster there are many Scots, who are really Strathclyde Celt-Euskarians from the western lowlands. So-called English settlers, many of them Welsh or Lancastrian, and others Norman, are scattered throughout the Pale. But, as a whole, Ireland is probably more Euskarian and less Aryan than any other part of Britain. In Scotland, the north and the Isles are Celt-Euskarian, with a large Scandinavian admixture; the Central Highlands are Euskarian with a very small Celtic element intermixed; the eastern Lowlands are mainly English; and the Western lowlands are peopled by Strathclyde Welshmen—that is to say, Celt-Euskarians, probably with a larger dash of Aryan Celtic and English blood than elsewhere. Wales is Euskarian at bottom, slightly Celticized, and with a little English and Norse blood. England itself is mainly English (or Low Dutch) in the south-east; English and Danish, with a little Celt-Euskarian admixture, in the Eastern Counties, the North, and the Midlands; English and Celt-Euskarian in the West country, and the Severn Valley; and Norse and Celt-Euskarian in Lancashire and the Lake District. Cornwall alone remains almost wholly Euskarian in type. All these statements, however, must be accepted merely in the rough, and they apply especially to the agricultural classes and the mass of the people. At the present day, the upper classes have intermarried all over the three kingdoms; the mercantile classes have moved about till Mac's and O's are as common in London as in Perthshire and Mayo; and even the artisans have poured into every great manufacturing town from all parts of the country. Ever since the beginning of the modern industrial movement, there has been a steady southward and eastward return-wave of Celt-Euskarian emigrants towards the more organized regions. Irishmen have poured into London, Liverpool, Glasgow, and South Wales; Highlanders into Glasgow, Edinburgh, and Paisley; Welshmen into London, Birmingham, Liverpool, and Manchester. At the present day, as Professor Huxley remarks, the dark type seems once more to be numerically superseding the light one.

Almost all of us are English in language, but most of us are only very partially English in blood. To put the same matter another way, our oldest element is the dark one, now scattered up and down through the population, and only gathered very sparingly into a little nucleus here or there in Ireland and Scotland. This element was Celticised, but not exterminated, by the Aryan Celts, and became with them the Celt-Euskarian "Ancient Britons" of our history books. Then the Celt-Euskarian was conquered by the Teutonic English, and Anglicised into the English of pre-Norman times. Next, these mixed English were conquered by Danes, whom they shortly absorbed. Dane and English were afterwards conquered by Normans, whom once more they absorbed. Dane and Irish in Ireland were next conquered and Anglicised by Norman-English, and the country further settled at various times by English and Scotch. Lastly, all these elements have coalesced with Welsh, Highland Scotch, and Scandinavians of the Isles, to form one heterogeneous British nation, so inextricably intermixed that its ethnology can now only be reconstructed in the rough. But all through, each earlier element has everywhere persisted in the resulting mixture, and it is probable that the numerical proportion of all the older elements, especially the Euskarian, is far greater than people generally at all imagine.

WINNING WAGERS.

BY THE EDITOR.

IT is rather singular that any writer who points out the folly, or worse, of wagering, is nearly always supposed by a large section of his readers to have wagered a great deal, and to be ready to wager a great deal more. An article I wrote about lotteries for the *Cornhill Magazine*, immediately brought me several invitations from the Continent and from America, to purchase tickets in sundry lotteries. Since I wrote about betting in KNOWLEDGE, I have been asked (who have never wagered a shilling on a race) to give hints for wise wagering whereby fortune may be gained without the usual equivalent of work done. My attention has been directed to the success which bookmakers have achieved, and I am asked to put the young and verdant sportsman on the track which has led to so agreeable a goal. I am further reminded that it is all nonsense for me to assert that betting and gambling must end badly in the long run, for if so much money is lost, much money must be won. "Why may not I," for instance, asks one, "be a successful votary of fortune, and win some of the money which you say is always lost by those who wager freely and often?"

Well, not only is this so (I have known a young City clerk win £1,500 on the Derby, and——regret it for years as the worst misfortune that had ever befallen him), but there are ways by which Fortune can be set on one side altogether, and money always won on a race, by anyone who, knowing how to proportion his wagers, can give time enough to the subject to get all the wagers made which the system requires.

At the outset let me note that it is by no means necessary that the system I am about to describe should be carried out in a precise and formal manner. If you have a tolerably large capital, or if, in case of failure, you have courage (greatly daring) to run away, you may leave a little to chance on every race, and then, if chance favours you, your gains will be proportionately greater.

The system is exceedingly simple; and it will be found that when the method of the great bookmakers is analysed a little, there underlies it the fundamental idea of the system; yet probably not one among them knows anything about it in detail, though he may thoroughly well understand that his method leaves very little to chance.

First, always lay odds against horses, never back them. This is not essential to the system regarded in its scientific aspect; but in practice, as will presently appear, it makes it easier to apply it.

Lay against every horse in a race as early as possible, when the odds are longest. If you lay against a few which are certain not to run, so much the better; that is so much clear gain to start with. Proportion your wagers so that the sum of what you lay against a horse, and what he is backed for, may amount to about the same for each horse. The precise system requires that it should be exactly the same, but you will find that you can often improve upon the system by taking advantage, in special cases, of your own knowledge of a horse's chance and your opponent's inexperience. In every case lay odds a point or two short of the legitimate odds against a horse. Suppose for a moment that the odds are ten to one against him, then it will always be easy to find folk who rather fancy the horse, and think the odds are not eight to one, or even six to one, against him; select such persons for your wagers about that horse. Convey carefully the idea that you also think his chance underrated at eight, or even nine, to one; but, as a favour, make the odds nine to one.

XUM

Of course, you need not search about for those who favour any given horse. Every greenhorn has a fancy for some horse, and is willing to take something short of the current odds for the privilege of backing him. You can, therefore, fill in your book *pro re natâ*, until at least you have made up your amounts for most of the horses engaged, when you will, of course, give more special attention to those whose leaf in your book is as yet incomplete.

Now let us take an illustrative case to see how this system works:—

Suppose there are nine horses in the race, to wit—A, B, C, D, E, F, G, H, and K. Let the odds be—

3 to 1	against	A
5 to 1	„	B
7 to 1	„	C
9 to 1	„	D
9 to 1	„	E
11 to 1	„	F
11 to 1	„	G
19 to 1	„	H
23 to 1	„	K

(You should be careful to note that when these odds are reduced to chances, becoming respectively

$\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{8}$, $\frac{1}{10}$, $\frac{1}{10}$, $\frac{1}{12}$, $\frac{1}{12}$, $\frac{1}{20}$, $\frac{1}{24}$,

their sum should be unity, or very near it. It does not matter at all—except to backers—if the sum is greater than unity, as it generally is, but if it should be less than unity, the exact application of the system would involve loss to you and gain to the backers, which is not your object.)

Well, then, you may let the wagers on each horse amount to £1,000 (or, for convenience, and to avoid fractions, say £1,200), if the race is important, and bets much in request; but the system, in its beautiful adaptibility, may be applied to shillings quite as well as to pounds.

Apart from the extra points you allow yourself, you ought to lay, in all—

£900 to £300	against	A
£1,000 to £200	„	B
£1,050 to £150	„	C
£1,080 to £120	„	D
£1,080 to £120	„	E
£1,100 to £100	„	F
£1,100 to £100	„	G
£1,140 to £60	„	H
£1,150 to £50	„	K

But you reason (with intending backers) that "the race is a moral certainty for A., and that it is giving away money" to lay more than (in all) £800 to £300. Again, "B. is a much better horse than people think, so that £900 to £200 is quite long enough odds against him;" as for C., "no wonder backers stand by him at the odds;" for your part you "think him better than B.; and see what Augur says of him!" and so forth, wherefore you cannot find it in conscience to lay more than £950 to £150 (in all) against him. (It gets easier as you reach the non-favourites to get the odds shortened.) So you deal with each, cutting off £100 (let us say); but with the horses low in favour, you can easily cut off more, and the system not only does not forbid this, but encourages it. Say, however, only £100, and then your book is complete.

You can now watch the race (if you like) with thorough enjoyment. The pleasure of the backers of the favourites is a good deal impaired by anxiety, and though backers of non-favourites have less to lose, they have more to gain and less chance of gaining it: so they too are anxious. But *you* can take a real scientific interest in the race. You may, if you please, try to recognise Muybridge's "Attitudes of the Galloping Horse," as the fleet steeds rush past your post of observation.

For, let the race go as it may, you clear £100. If A wins, you pay his backers willingly £800, receiving £200 from the backers of B, £150 from those of C, and so on—in all, £900. If B wins, you pay his backers £900, and receive from the backers of A, C, D, &c., £1,000, and so on, whichever horse may win. You need not, as a rule, be afraid about being paid; these are debts of honour, and to be paid therefore before all sordid trade debts—nay, so sacred are these debts, that many of your clients would deem it better to break open a till, or to embezzle a round sum from an employer, than to leave them unpaid. So that you need be under no anxiety.

It occurs to me that some of my betting readers may say, We have not time for this; we do not want to be bookmakers, but to make our occasional wagers on safe lines, as *they* do their systematic ones. In that case, you might back each horse in the race once, so that the total wagered about him by you and the bookmakers may be a fixed sum, *less* whatever you can get off the market odds. For instance, say the sum is to be £120, in the case of each horse in the above list; then you should back A at the odds of £90 to whatever sum less than £30 a bookmaker will take. Suppose (I cannot suppose it myself, but you may) he will give you £90 to £29; and that you can arrange similarly for each horse of the nine, offering to back him for a sum always £1 short of the true amount at the odds. Then you will gain £1, however the race may end. It is not much,—but I wish you may get it.

It is easier to tell you how to lose. This may be effected by adopting *the other part* of the bookmaker's system. *He* always lays the odds a little short: do you always take them so. Back the favourite boldly; but do not fail to take fancies for non-favourites, and back your fancies boldly too. It would be absurd to haggle about odds in the case of a horse which is morally sure to win, or to insist on ten to one when you feel sure the odds are not seven to one against a horse. When you win, assure yourself you are "in the vein," and go on betting; if you lose, assure yourself "the luck must change," and go on betting. By continuing patiently on this course, it will be strange if you do not learn before long—how it is that the bookmakers make so much money.

Let me, in conclusion, quote two short passages, one from a letter by Charles Dickens, the other from a speech by Lord Chief Justice Cockburn. The first seems to relate to the successful book-maker—"I look at the back of his bad head repeated in long lines on the racecourse, and in the betting stand, and outside the betting rooms, and I vow to God I can see nothing in it but cruelty, covetousness, calculation, insensibility, and low wickedness. . . . . If a boy with any good in him, but with a dawning propensity to sporting and betting, were but brought here soon enough, it would cure him." The other passage applies to the bookmaker and his victim alike—"the pernicious and fatal habit" of betting "is so demoralising and degrading, that, like some foul leprosy, it will eat away the conscience until a man comes to think that it is his duty to himself to "do his neighbour as his neighbour would do" him.

FOUND LINKS.

By Dr. Andrew Wilson, F.R.S.E., F.L.S.

PART VII.

A CORRESPONDENT, "J. Fisher, M.D.," in a letter addressed to the Editor of KNOWLEDGE, remarks that the names "Quadrupeds" and "Mammals," used by me as synonymous terms, and, I may add, in strict

accordance with natural history usage, are apt to convey what he is pleased to call an "erroneous impression." He remarks that the whale is a "Mammal," but not a "Quadruped"—meaning, of course, that a whale has not four legs. Dr. Fisher may, perhaps, have heard the remark that a good deal in this world depends upon one's point of view; and his point of view happens in this case not to be mine. I carefully explained that I used the terms "Quadruped" and "Mammal" as convertible names, and this for the reason that in zoology—as, indeed, in every-day life—the names are so employed. Has Dr. Fisher ever heard of a frog (one of his examples) being called a "Quadruped," in the same breath with an ox? And does he not know that a whale possesses all the essential characters of quadruped-life which he himself rejoices in the possession of? As to a whale not possessing four limbs, perhaps Dr. Fisher, not being a zoologist, is not aware that in some whales (*e.g.*, the whalebone genus, or *Balæna*) there are actual representatives, not merely of the haunch-bones, but of the thighs as well. Hence, a whale may claim to be a quadruped, even although its hind-limbs are rudimentary. Dr. Fisher's somewhat querulous objections are overruled by the fact, that, as I started by defining "Quadrupeds" and "Mammals" as being one and the same, the scientific meaning (and, as I maintain, the popular meaning also) of these terms is not likely to be mistaken by any reader of ordinary intelligence. It is true, as Dr. Fisher remarks, that in many mammals, the clavicles, or collar-bones, are wanting, just as these bones are absent in some members of an order (*e.g.*, rodents) and present in others; or, as is the case with the guinea-pigs and rabbits, the clavicles may be wanting at birth, and become developed later. What I indicated in my paper (KNOWLEDGE, No. 25) was the typical condition of the quadruped shoulder. If Dr. Fisher maintains that it is more typical for a quadruped to want collar-bones than to possess them, that is his affair. He is not likely to find any comparative anatomist to agree with him.

In the present paper I purpose to give an outline of the means whereby the zoologist has been enabled to supply "links" between the *Vertebrate*, or "backboned" animals, and the *Invertebrate*, or "boneless" animals. Ever since the time of Lamarck, the distinction between the highest, or *Vertebrated* animals (fishes, frogs, reptiles, birds, and mammals or quadrupeds) and the *Invertebrate* groups, has been recognised as one of very clear nature. And modern zoology, dealing merely with the structure of the animals in question, fully recognises the apparent gap which intervenes between the great array of boneless animals—such as worms, insects, shell-fish, &c.—and the "backboned" group. But, as in many other cases, a closer examination of the lowest Vertebrate group seems to demonstrate that the gulf between the highest animals and their Invertebrate neighbours is by no means so wide or impassable as, at first sight, it appears to be. The lowest fish and Vertebrate is the *Amphioxus*, or Lancelet (Fig. 1). This is a little clear-bodied fish—formerly regarded as a kind of slug—found inhabiting sand-banks in various quarters of the world. It attains a length of an inch or two, and is pointed at each end. It has a kind of back and tail fin, but possesses none of the "paired" fins, which, existent in most other fishes, represent the limbs of higher animals. The mouth (*o*) is an oval slit, and is fringed with gristly filaments. The lancelet has no brain, heart, bones, skull, ears, or kidneys. It is the only vertebrate which wants a heart, and it is likewise the only vertebrate in which the blood is colourless. Along the back runs the only representative of the skeleton—namely, a soft rod-like body, called the *notochord* (*n*). This structure, by the way, is found in the early development of every vertebrate animal, being replaced in all, save a few fishes, as time passes, by the spine itself. Above this rod lies the nervous cord of the lancelet. The mouth opens into a very wide throat or *pharynx* (*b*), whose walls are perforated with slits that open into the cavity of the body. The walls of this great throat are richly set with the microscopic processes called *cilia*, which, by their incessant waving, circulate the water admitted to the cavity. The throat leads into a simple stomach (*g*), and

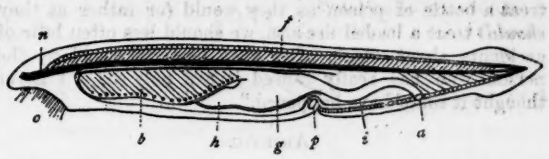


Fig. 1.—The Lancelet (*Amphioxus lanceolatus*), enlarged to twice its natural size. (*o* Mouth; *b* Enlarged pharynx; *g* Stomach; *h* Sac representing the liver; *i* Intestine; *a* Anus; *n* Notochord; *f* Rudiments of fin-rays; *p* Abdominal pore).

this, in turn, leads into the intestine (*i*). A liver (*h*) of the most rudimentary description also exists. The blood, in the absence of a heart, is circulated by the contractions of the bloodvessels, and it is interesting to note that the arrangement seen in all vertebrates, whereby a portion of the venous, or impure blood, is sent to the liver for the manufacture of bile, is represented even in this curious fish. When the lancelet breathes, water is received into the throat, passes over the network of bloodvessels in the walls thereof, and after giving up its oxygen to the blood, is sent by the ciliary action through the slits in the throat into the body cavity. Thence it is expelled through a small opening near the tail, and called the *abdominal pore* (*p*).

The lancelet differs from every other vertebrate animal in the absence of a heart, skull, brain, and kidneys, and in the colourless blood; in the peculiar and rudimentary liver; and in a digestive system, which, like the throat, is also lined with *cilia*. But that it *is* a vertebrate is proved by the presence of the *notochord* (*n*), already remarked as being developed in the early life of every vertebrate animal. The supply of venous blood to the liver is also a vertebrate character; whilst its development, studied from the egg onwards, no less clearly shows its right and title to be regarded as a true vertebrate.

HOME CURES FOR POISONS.

NO one who is wise will fail to send at once for a doctor when poison has been taken, either by inadvertence or otherwise. But there are often remedies or antidotes close at hand, which may be of great use, even to the saving of life, if taken at once. It is not with any idea of encouraging people in such cases to do without the doctor, but to indicate certain home cures for even the most violent poisons, to which recourse can be had before he comes, that we write this series of short papers. There are cases in which the nature of a poison taken inadvertently can be determined at once, when therefore the proper home cure, if such there be, is at once known. There are other cases in which, though it be not known what poison has been taken, the symptoms presently show at least the class of poisons to which the substance belongs; in many such cases the remedy is as certainly indicated as though the

precise nature of the poison were known. We shall consider cases of both kinds. But first, as

PREVENTION

is better than cure, we may remind the reader that every substance, whether medicinal or otherwise—every drug or chemical which has poisonous qualities—should be not only properly labelled, but carefully kept out of harm's way, and where there are children, should be kept under lock and key. Better take precautions which seem unnecessary, than run risks which may be avoided. If people would treat a bottle of poison as they would (or rather as they *should*) treat a loaded fire-arm, we should less often hear of accidents about which, after they have taken place, the person who has really caused it can only say, "I never thought it *could* have happened."

ARSENIC.

Arsenic has very little taste in the form in which it is usually known in commerce—viz., as white arsenic or arsenious acid, the white oxide of arsenic. For this reason, it is often used for criminal purposes. But fortunately, if it can be given easily, it can be detected as readily in the body, not only when present in very minute quantities, but after many weeks and even months have elapsed from the time when the body was buried.

The first symptoms noticed after arsenic has been swallowed are sickness and faintness, following generally within half-an-hour after the poison has been taken, but often much sooner. Then follow violent and spasmodic pains in the bowels (increased by pressure), attended by a burning feeling, dryness, heat and constriction of the mouth and throat, increased flow of saliva, and an unquenchable thirst, itching of the face and neck, and palpitation of the heart, with full, hard, and frequent pulse. Vomiting and purging follow. Sometimes the skin is burning hot, at others icy cold and covered with clammy perspiration. The pulse sinks, becoming irregular and feeble. Then, if the poison has been given in sufficient quantity, convulsions come, and before long death ensues. In certain rare instances the symptoms above described are scarcely observable, yet within a few hours the patient sinks; in such cases the presence of arsenic is indicated by a lethargic sleep. In cases of slow poisoning by arsenic (which, however, do not belong properly to our subject, since in their case the physician only can be of service) there is often no recognisable symptom, no inflammation, no fever, constipation, or vomiting, but langour, weariness, and disgust for food, followed by torpidity of the nobler organs, especially the lungs—death coming as certainly, though not so swiftly, as when a single poisonous dose has been taken.

The best home remedy for arsenical poisoning is a mustard emetic, but if sulphate of zinc can be obtained, an emetic formed of from ten to twenty grains in about a quarter of a tumbler of water, is better. For a mustard emetic, take a dessert-spoonful of flour of mustard in a teacupful of warm (not hot) water. Large quantities of milk or warm water, or, better still, linseed-tea or barley-water, should be taken, to promote vomiting. Tickling the back of the throat with a feather, or with the fore-finger (if the patient has been accustomed to that way of producing vomiting) may be resorted to with advantage. The patient should note, in all cases where the stomach is to be cleared of its contents, that, while much is rejected after the throat has been tickled, it is well after a while to wait for the sort of after-throe which comes without such tickling, and seems to carry away a portion of the stomach's contents which is retained so long as the tickling is continued. It is better, however, to encourage vomiting rather by swallowing large quantities of the warm liquids above-named than by irritating the back of the throat.

After the stomach has been cleared of its contents by the use of emetics, &c., lime-water, or chalk dissolved in water, should be swallowed in large quantities. Or, if none is at hand, mix a pound of soap in two quarts of water, and take a teacupful every five or six minutes. Failing either of these, powdered charcoal, if at hand, may be taken with advantage. It will be well for the patient, however, if, before this stage of the treatment, a doctor is at hand to take the case in charge. The after treatment requires all the doctor's care in serious cases; for the above remedies are not, properly speaking, antidotes.

THE AMATEUR ELECTRICIAN.

OUR next task is to fix the inductor, &c. To do this, take a piece of brass plate a quarter of an inch thick, twelve inches long, and shaped according to the dimensions given in Fig. 7, which is a plan of the plate,

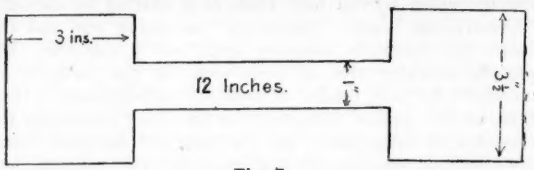


Fig. 7.

minus the parts which are to be fixed to it. It is represented in section by A B in Fig. 8. The lower pole-piece, E F (C, Fig. 6, May 26), is to be screwed on say at C C C, the heads of the screws being well sunk. P P′ are two brass standards, or pillars, about two inches high, to support the steel screws S S′, which form the centres upon which the armature will revolve. These standards should be very strong and firmly fixed*. They should be half an inch thick, and shaped (in a vertical plane at right angles to the axis), according to Fig. 9. This will tend to considerably increase the rigidity and durability of the machine. The centre-screws should, of course, be fixed by means of check-nuts on each side of the standards.

When all is done, the plate, AB, must be firmly screwed at available places (Fig. 8, G) to a stout wooden base, of which, however, more will be said when speaking of the motive power next week. We have advised the use of centres, as opposed to bearings, to obtain the best results with the least expenditure of force, and because, further-

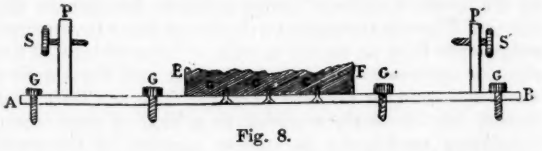


Fig. 8.

more, of the small weight which has to revolve. Where, however, a larger armature is used, or if even with the one described, a high velocity is attempted, bearings should be adopted; otherwise, the wear and tear would be very great, and we should soon spoil our machine.

As regards the commutator (Fig. 5, May 26), the one we are adopting is constructed on a principle which in-

* It would be better, where it is possible, to have the plate and standards cast in one piece, the standards being 9 in. apart.

volves a fractional loss of current, but, at the same time, it removes an element of danger. The ordinary commutator consists of a cylinder of metal cut crossways, and so dividing it into two parts. This, however, involves the short-circuiting of the armature for a brief fraction of time twice during each revolution; heat is in consequence produced. We have preferred, therefore, to recommend a total disconnection of the circuit twice in each revolution. This may seem a great loss, but really it is very trifling. It also tends to keep the armature cool, and, above all, it has been found to answer well in the Brush dynamo-machine. We must, however, take care that our disconnections are made at the right time. Our readers will recollect that in the introductory article we stated that a certain current was induced as one pole of a magnet was inserted in the coil, while the opposite current was induced by withdrawing the magnet. Similarly and conversely the approach of one pole, say the north, produces the same electrical effect as withdrawing the other or south pole. Referring once more to Fig. 6, we must regard the coil of wire as surrounding an ordinary soft iron core, whose ends (A. B., Fig. 1, May 5th) become north or south, according to the relative position of the armature. Let us for a moment

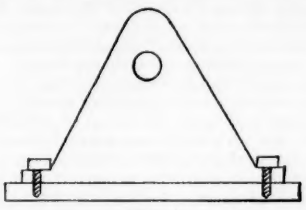


Fig. 9.

associate ourselves with one end or side of the core, and let the armature perform a quarter of a revolution, so that our end is uppermost. As it starts revolving (say to the right) it gradually leaves the north pole of the magnetic system, and at the same time approaches the south pole. Going *from* the north and *to* the south, it is necessarily subjected to the same magnetic influence, accompanied by a similar effect on the coil of wire. At the moment that our end is crossing the vertical line, no current is produced. Of course, as the end ascends on the opposite side, passing from south to north, the opposite magnetic, and therefore electrical, effect is produced. We must, therefore, to get the best effect, so arrange our commutator that the "brushes" or "collectors" rest on the small insulated pieces of metal (C. D., Fig. 5), when the core is in the vertical plane. How shall we do this? Space compels us to defer the answer to this question till next week.

ERRATUM.—In last week's article, page 619, second column, line 19, read ·7 lb. for 7 lb.

THE ECLIPSE.

WE have received the following interesting communication from Mr. A. C. Ranyard, who kindly undertook to forward communications to us respecting the eclipse.

"Sohag, Upper Egypt,
"*May* 17, 1882.

"I am sorry that you were not able to come out to the eclipse. The weather has been all that could be desired, and the Corona magnificent, in a perfectly clear sky, with a bright comet within about half a degree of the moon's limb. The difficulties have been very slight, and the trouble caused by heat and flies much less than we were led to expect. We have lived in great comfort on board a steamer anchored alongside our tents. The Khedive has entertained us at his personal expense, and has had pillars built for our instruments, besides giving us a guard of soldiers and water-carriers, who have perseveringly endeavoured to keep down the dust round our station by means of water carried up from the hill and distributed from goat skins. I had made every preparation to defend my instruments from the wind which frequently springs up during totality, but instead of a wind there was a dead calm.

"The Corona was of the sun-spot maximum type, with no very marked rifts. As seen in the telescope it was full of structure, delicate lines of light curving hither and thither, and arranged in great groups. There was one very marked, long, straight ray, and several structures like great prominences stretching to a height of 15 or 20 minutes. These are shown in my photographs, as well as the comet, which has registered itself, together with about half a degree of its tail, on some of the plates. I did not succeed in obtaining a photograph of the spectrum of Young's reversing stratum, though the bright lines were well seen for about three seconds.—Yours sincerely, A. C. RANYARD."

BUTTERFLIES AND MOTHS.

BY W. J. H. CLARK.

WE have now arrived at one of the busiest months of the year for the entomologist; every bush and tree teems with insect life, and both butterflies and moths in the *imago* or perfect state, and *larvæ* and *pupæ*, are to be found everywhere. The collector has only to take out his net or sugaring-pot, as the case may be, and a profusion of game is sure to meet his eyes.

Among the butterflies that are out now we may notice the handsome, but rather scarce, Swallow Tail (*Papilio Machaon*), seldom to be found but in the fens of Cambridge, the Brimstone (*Gonepteryx Rhamni*), the well-known Large Garden White (*Pieris Brassicæ*), the Small White (*Pieris Rapæ*), the Green-Veined White (*Pieris Napi*), the Orange Tip (*Euchelia Cardamines*), the Pearl-Bordered Fritillary (*Argynnis Euphrosyne*), the Greasy Fritillary (*Melitæa Artemis*), the Glanville Fritillary (*Melitæa Cinxia*), the Speckled Wood (*Satyrus Ægeria*), the Wall Brown (*Satyrus Megæra*), the Green and the Purple Hairstreaks (*Thecla Rubi* and *Thecla Quercus*), the Small Copper (*Polyommatus Phlæas*), Brown Argus (*Lycæna Agestis*), Silver-Studded Blue, and Small Blue (*Lycæna Ægon* and *Lycæna Alsus*).

Great numbers of the moths make their appearance now, and many of the common hawk moths will be out some time during the month. In the course of the ensuing weeks we may probably find the following:—The Eyed Hawk (*Smerinthus Ocellatus*), the Poplar Hawk (*Smerinthus Populi*), the Lime Hawk (*Smerinthus Tiliæ*), the rare Spurge Hawk (*Deilephila Euphorbiæ*), the very pretty small Elephant Hawk (*Chærocampa Porcellus*), the Humming-bird Hawk (*Macroglossa Stellatarum*), remarkable for its rapid flight and habit of hovering steadily over a flower whilst thrusting in its exceedingly long proboscis to obtain its food. The Broad and Narrow-bordered Bee Hawks (*Macroglossa Fuciformis* and *Macroglossa Bombyliformis*), two insects which take their names from a striking resemblance they possess to the Wild Bee.

The commonest of our Clearwing Moths, the little Currant Clearwing (*Sesia Tipuliformis*), is now on the wing, and is generally to be found on or near currant bushes.

The Common Swift (*Hepialus Lupulinus*) and Ghost Swift (*Hepialus Humuli*) are both out now. The male Humuli is a most handsome insect, the wings being pure white, with yellow edges on the upper, and of a dusky black on the under side; it is a very abundant species. The pretty little Green Forester (*Ino Statices*), the Least Black Arches (*Nola Cristulalis*), the Cinnabar (*Euchelia Jacobææ*), Wood Tiger (*Chelonia Plantaginis*), White Ermine (*Arctia Menthrasti*), Pale Tussock (*Orgyia Pudibunda*), and Lappet (*Lasiocampa Quercifolia*) are all on the wing.

Among the GEOMETRÆ Family, the Spotted Yellow (*Venilia Maculata*), Scorched Wing (*Eurymene Dolobraria*), Scalloped Hazel (*Odontoptera Bidentata*), Brimstone (*Rumia Crataegata*), the very

common Currant Moth (*Abraxas Grossulariata*), together with many others, may be found in the beginning of this month.

Several of the CUSPIDATÆ are now out, the Puss Moth (*Cerura Vinula*) and the Pebble Prominent (*Notodonta Ziczac*) being most common.

A great number of the NOCTUÆ are now on the wing. Among them we may expect to find the following:—The Alder (*Acronycta Alni*), the Bramble (*Acronycta Rumicis*), Common Wainscot (*Leucania Pallens*), Bird's Wing (*Dipterygia Pinastri*), Doubtful Nutmeg (*Mamestra Anceps*), Cabbage Moth (*Mamestra Brassicæ*), Treble Lines (*Grammesia Trilinea*), Double Square Spot (*Noctua Triangulum*), &c. These, and several others more or less scarce, are to be obtained during the beginning of the month, but success depends in a great measure on weather and other extraneous circumstances.

In all cases I have given, and shall continue to give, the Latin names together with the English, the former being most important. The first Latin name shows to what family the insect belongs, the second the specific name is used only for that particular individual. The specific name must be learnt together with the English, as genuine collectors invariably employ the former when speaking of a butterfly or moth, the advantage being that many insects have purely local names, and an entomologist from, say, the south of England, would find the same insect called by a very different English name in the north country, but the Latin appellation is the same all over the world.

A great many caterpillars are to be found this month on the trees and hedges, and next week we will give a short list of them; together with their haunts and food. If the lepidopterist comes across any in the course of his travels he would do well to box them together with a piece of the tree on which they are feeding, and breed them up. A hat-box with a piece of net stretched over the top acts as a fair elementary breeding-house, but next week we will describe the manner of making a good one. Feed the caterpillar once a-day with fresh leaves, but do not handle them, as they are very delicately organised, and a slight squeeze might do them considerable injury.

MASS AND WEIGHT OF THE BRAIN.

IN his able treatise, entitled "An Introduction to Human Anatomy," Professor Turner, of the University of Edinburgh, writes thus on "The Mass and Weight of the Brain":—

The human brain is absolutely bigger and heavier than the brain of any animal, excepting the elephant and the larger whales. The brain of the elephant is said to weigh from 8 lb. to 10 lb., and that of a large finner whale between 5 lb. and 6 lb. The human brain is also heavier relatively to the bulk and weight of the body than are the brains of the lower animals, except in some small birds and mammals. Considerable variations, however, exist in the size and weight of the human brain, not only in the different races of mankind, but in individuals of the same race and in the two sexes. The heaviest brains occur in the white races. The average weight of the adult European male brain is 49 oz. to 50 oz. (about 3 lb.), that of the adult female 44 oz. to 45 oz.; so that the brain of a man is, on the average, fully 10 per cent. heavier than that of a woman. The greater weight of the brain in man, as compared with woman, is not in relation merely to his greater bulk, but is a fundamental sexual distinction; for, whilst there is a difference of 10 per cent. in the brain weight, the average stature of women is, according to Thurnam's calculations, only 8 per cent. less than that of men.*

Dr. Boyd states that the average weight of the brain in the newly-born male infant is 11·67 oz.; in the female only 10 oz. The exact age at which the brain reaches its maximum size has been variously placed at from the third to the eighth year by different authors; but it continues to increase in weight to 25, or 30, or even 40. After 60 the brain begins to diminish in weight; in aged males the average weight is about 45 oz.; in females about 41 oz.

In some cases the adult brain considerably exceeds the average weight. The brains of several men distinguished for their intellectual attainments have been weighed. The brain of Cuvier weighed 64½ oz.; of Dr. Abercrombie, 63 oz.; of Professor Goodsir, 57½ oz.; of Spurzheim, 55 oz.; of Sir J. Y. Simpson, 54 oz.; of Agassiz, 53·4 oz.; and of Dr. Chalmers, 53 oz. But high brain weights have been found where there was no evidence of great intellectual capacity. Peacock weighed four male brains, which ranged from 62·75 oz. to 61 oz.; Boyd, a specimen of 60·75 oz.; and I have in my possession one of a boy, aged 15, which weighed 60 oz. In the brains of the insane, high brain weights have also been observed. Bucknill met with a brain in a male epileptic which weighed 64½ oz.; Thurnam one which weighed 62 oz.; and in the West Riding Asylum, out of 375 males examined, the weight of the brain in 30 cases was 55 oz. or upwards, and the highest weights were 61 oz. in a case of senile dementia, 60½ oz. in a case of dementia, and 60 in a case of melancholia. No case has as yet been recorded of the weight of the brain in a woman of great intellectual attainments; but Boyd met with a woman's brain as high as 55·25 oz., and many instances of upwards of 50 oz. in women where there was no evidence of high mental endowment. Skae, in a female monomaniac, observed a brain which weighed 61½ oz.; and of 300 females examined in the West Riding Asylum, the weight of the brain in 26 cases was 50 oz. or upwards, the highest weights being 56 oz. and 55 oz. in two cases of mania.

The size and weight of the brain do not, therefore, *per se*, give an exact method of estimating the intellectual power of the individual, and a high brain weight and great intellectual capacity are not necessarily correlated with each other.

[* If this is so, the brains of women are more massive relatively than those of men, for the weight varies, *cæteris paribus*, as the cube of the height, so that the weight of woman is less than that of man by 92 cubed, as 778688 is less than 1,000,000, or by more than 22 per cent.—ED.]

TOO MUCH BRAIN-WORK.

"ON April 28, Dr. Richardson, F.R.S., delivering a lecture on 'National Necessities as the Bases of Natural Education,' before the Society of Arts, brought forward," writes F.C.S., "the following extract, which happened to be a report of the Chairman of the evening, Mr. Edwin Chadwick, C.B., to the British Association in 1860, to show what an evil effect too much brain-work, without a proportional amount of industrial occupation to support it, has upon young children. I give the extract *verbatim*, as it bears closely on a point recently under discussion:—

"In one large establishment, containing about six hundred children, half girls and half boys, the means of industrial occupation were gained for the girls before any were obtained for the boys. The girls were therefore put upon half-time tuitions; that is to say, their time of book-instruction was reduced from thirty-six hours to eighteen per week, given on the three alternate days of their industrial occupation, the boys remaining at full school time of thirty-six hours per week, the teaching being the same, on the same system, and by the same teachers, the same school attendance in weeks and years in both cases. On the periodical examination of the school, surprise was expressed by the inspectors at finding how much more alert, mentally, the girls were than the boys, and in advance in book attainments. Subsequently, industrial occupation was found for the boys, when their time of book instruction was reduced from thirty-six hours a week to eighteen; and after a while, the boys were proved, upon examination, to have obtained their previous relative position, which was in advance of the girls."

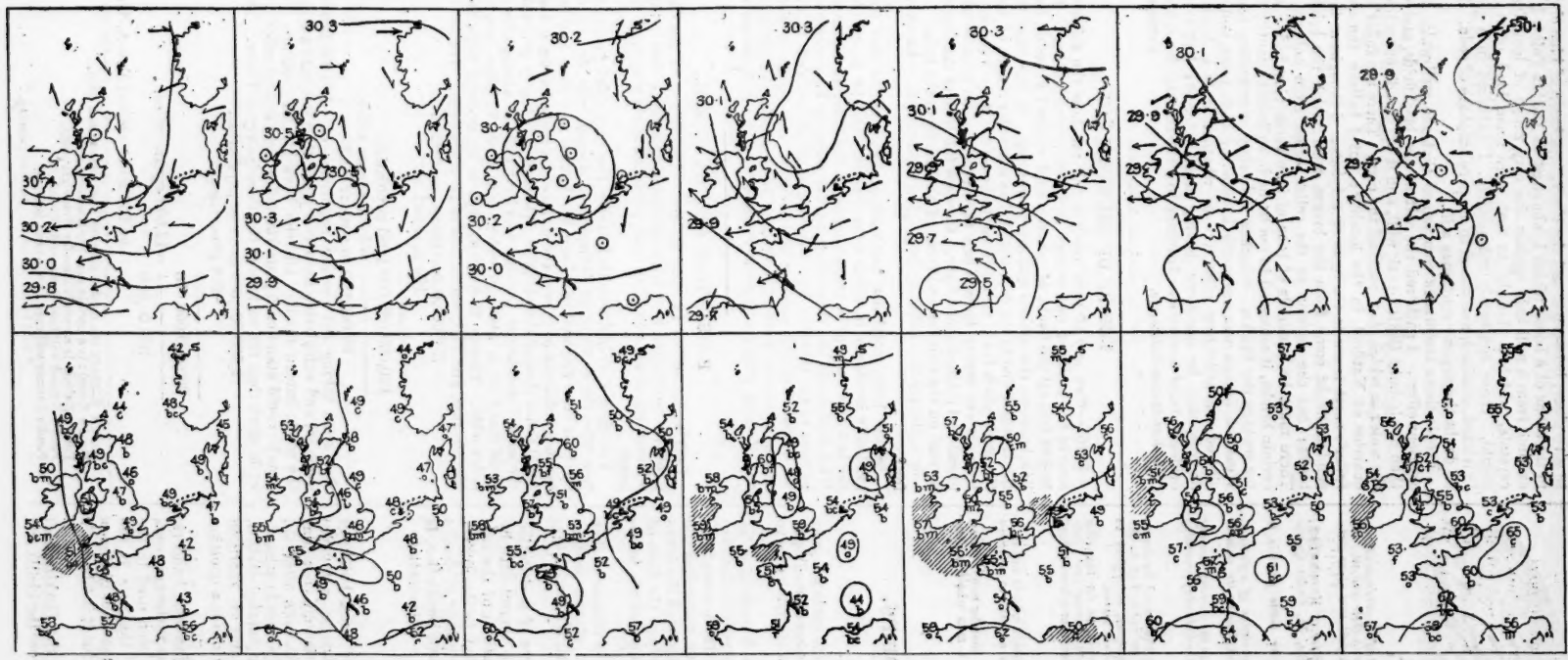
BRAIN TROUBLES.

I HAVE carefully read "Brain Troubles," and have met with many changes which might seem alarming to one who knows not the influence of digestion on the mind. The cases I am now going to give are due to indigestion or some irritation of the stomach on the controlling powers of the brain. After a heavy meal, especially after a heavy breakfast, I find some of my patients cannot write proper English. They say they can express their thoughts, but not in proper style. Other times they cannot express them at all. If they try to do so, they find they have forgotten half of their subject. If they continue to write in spite of this, they run words into each other. Thus, in writing "other rogues," they put down "other ogues," and often drop a word out of the sentence. Sometimes they mis-spell a word, know that it is wrongly spelt, and yet cannot find out the mistake, unless they consult a dictionary. The same in adding up a sum, or multiplying; when they come to prove a sum they find it wrong, yet cannot find out where the mistake is for a time. They may change letters in different words, thus in writing "good boy" they may put down "goob doy." There are other little things which an observer may notice, and which are not signs of brain troubles, but of indigestion, or of some improper material in the blood giving rise to these symptoms. These are not usually seen before a meal, or after a light one.

Again, irritability of temper most often means indigestion, or too full bloodvessels. Whenever I feel vexed at any trifling annoyance, I know I am suffering from too much food. I go for a walk or take some exercise, and so get rid of my spleen! I hope this may be taken in its true light, and not as a criticism on "Brain Troubles."

T. R. ALLINSON, L.R.C.P., &c.

WEATHER CHARTS FOR WEEK ENDING MONDAY, MAY 22.



EXPLANATION OF CHARTS.—The two charts for each day show the general condition of the weather over Western Europe at 8 a.m. In the upper chart the height of the barometer is expressed by "isobars," the value of each line being given in figures. The prevalent winds are shown by arrows, which are drawn flying *with the wind*, the force being indicated thus: ⟶ = a heavy gale; ⟶ = a gale; ⟶ = a fresh to strong breeze; ⟶ = a light to moderate breeze; and ⊙ = a calm. In the lower chart the weather is indicated as follows:—b = blue sky; c = detached clouds; o = overcast; m = misty (hazy); f = foggy; q = squally; r = rain; h = hail; s = snow; l = lightning; and t = thunder. The general distribution of temperature is shown by "isotherms," and the readings at certain places are given in figures. Diagonal lines = rough sea, the shading being proportional to the disturbance.

OUR WEATHER DIAGRAM.

WE have finally decided on the plan to be followed with respect to weather diagrams in KNOWLEDGE. We propose to give each week eight such diagrams (the 6 P.M. diagrams) as appear in the *Times* for six days only in each week, repeating always the last diagram of one week as the first diagram for the next week. Thus, in this and future volumes of KNOWLEDGE there will be a continuous weather record, very valuable and convenient for reference.

THE COMET.

WE had intended to republish this week our map of the Comet's path, which appeared in KNOWLEDGE for May 19. But the chance of seeing the Comet at all with the naked eye is now so small that it has not seemed worth while so to use our limited space. The map, as published, gives the place of the Comet up to the very latest time when it could be seen in the night. Later, it will only be above the horizon in the day-time. It is unlikely to be a conspicuous object when seen in the southern hemisphere. It will be interesting to see whether the comet, which is now near the sun in the skies—we may call it the eclipse comet—will appear in the skies of either the northern or the southern hemisphere.

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Letters which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

Our Correspondence Columns.

MACAULAY ON SMALL-POX.

[414]—As an addendum to what Macaulay says (as quoted in your edition of Saturday last), in respect of the prevalence of small-pox 200 years ago, permit me to call your attention to his opinion as to the value of vaccination as a preventive.

"In spite of these eloquent eulogies (on the introduction of Heming's lamps for the purpose of lighting the streets of London) the cause of darkness was not left undefended. There were fools in that age who opposed the introduction of what was called the new light, as strenuously as fools in our age have opposed the introduction of vaccination and railroads; as strenuously as the fools of an age anterior to the dawn of history doubtless opposed the introduction of the plough and of alphabetical writing."

As showing the intensity and prevalence of the disease at that time, I may parenthetically mention that three of the leading characters of that reign suffered most severely, viz., William, Mary, and Bentinck; Mary dying of it.

Direct and positive evidence of the terrible nature of a visitation of small-pox on a population entirely (or nearly so) unprotected by vaccination, is afforded by the accounts which reach us of the outbreak now raging in the Island of Hayti (reported in the *British Medical Journal* a week or two since), when the number of deaths during this single outbreak, and amongst a sparse population, is calculated at no less than 20,000 victims. OBSERVER.

A MISPLACED SPA.

[415]—Most people must have noticed that new brick buildings are often defaced by a white incrustation which disappears in damp weather and reappears in sunshine, and often obstinately continues to do so, on parts of buildings sheltered from rain, even after the structure is no longer new. An example may be seen in a handsome Wesleyan church in the Anerley-road, near Anerley station, and in new houses and walls about Red Hill, and at Thornton Heath, near Beulah Spa; and in what other localities is a question deserving investigation.

On asking the cause of this from workmen, foremen, builders, and even from a local architect, I have received the various answers that it was lime, saltpetre, and that sea salt had been used in the mortar; only yesterday, I was told confidently, "that, sir, is the chalk drying out." It is curious that so remediable an unsightliness has not been better examined by these experts, for it is Glauber's salt, and therefore easily removable.

At the foot of the Surrey Highlands, where the Dorking and Reigate sand begins, east of Reigate, to diverge from the chalk, and to give place, between it and the chalk, to a basin of blue clay, and in the cellar of a house which I inhabited at Gatton Point, I found exuding from a wall built against the clay, crops of long feathery crystals, which I thought at first were some kind of vegetable mould. These constantly reappearing, I gathered in a gallipot, lixiviated, strained, and found to be pure sulphate of soda. I have no doubt the deposit continues still.

People there sometimes complained that the well-water had an aperient effect. I gathered the salt at the brickfields, and on the then newly-built Gatton-park wall, and it appeared concentrated in the water in which they puddled the clay. There are fuller's earth quarries at Nutfield, in the locality; but I believe the soda in fuller's earth is not in the form of sulphate. I thought at first the sulphur might come from the breeze with which the bricks are burnt; but the deposit in the cellar came from unburnt clay. There must be hundreds of tons of it in these clay beds; and, in certain bricks, it appeared to me to be in sufficient quantity to pay for soaking the bricks. Whether the valley surrounding the high Weald of Sussex was anciently invaded by high tides, and this is altered sea salt—how altered?—or whether it is a fresh-water deposit, may be questions having some interest; but it would evidently be of immediate advantage to scrub this misplaced aperient from handsome buildings. CURIOSITY.

TIMBRE OF TRUMPET, ETC.

[416]—Can any of your readers tell me how the difference of tone in the trumpet and cornet is to be accounted for? I have looked into all the books on physics and music I know of, but this link between the science and art is wanting. Is the finer tone of the trumpet due to the fact that it has a greater length of tube for the same pitch (as it seems to me to have)? If so, I suppose that trumpet and cornet have much the same relation to each other as grand and cottage piano have. Or, does the tone of the instrument depend on the number and form of the bends in the tube? If so, how is the greater difficulty in playing the trumpet to be accounted for?

In the horn, trombone, bombardon, &c., I notice that the tube gradually increases in width from a point near the mouthpiece to the bell (the ratio of increase varying in the different instruments). With this exception, these instruments seem to be exactly similar in form to the trumpet and some forms of cornet, and this makes me think that the number and form of the bends in the tube cannot appreciably affect the tone. Information and correction on any of these points will greatly oblige, P. E. SWINSTEAD.

POPULATION OF THE EARTH.

[417]—Adverting to your article, "Population of the Earth," p. 584, KNOWLEDGE, may I be permitted to remark that it suggests a lesson which all moralists and philanthropists may well take to heart.

You show that had mankind during the past 4,000 years been as free from the decimating influences of disease, war, &c., as during the past year England has been, the human race then had been in number sufficient to throng the surface of a globe having a diameter 5,000 times that of the earth's. Whereas, it is highly probable that the actual number of persons who have existed during this period could stand on a plain in extent less than 70 miles long and 60 miles wide. That is, if we may reckon an average population of 750,000,000, and 160 generations of 25 years each. Thus—

$$\frac{750{,}000{,}000 \text{ average population.} \times 160 \text{ generations.}}{30{,}000{,}000 \text{ to a square mile.}} = 4{,}000 \text{ square miles.}$$

But, even taking the present population of 1,500,000,000 as the average, and calculating for 6,000 years, then it would appear that the whole human family—all who have had an existence [in that time]—could stand on a plain 150 miles long and 80 miles wide, or little more than the surface of the Principality of Wales. Thus—

$$\frac{1{,}500{,}000{,}000 \text{ average population.} \times 240 \text{ generations.}}{30{,}000{,}000} = 12{,}000 \text{ square miles.}$$

or 150 miles × 80 miles.—A. WOOD.

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Answers to Correspondents.

*** *All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

J. HARTINGTON. You consider that with our present circulation (which you under-rate, by-the-way, for our first volume has reached many more than the 20,000 you mention) we ought not to think of increasing our price. We do *not* think of so doing. But we think it probable you form inadequate ideas of the relation between the expenses and the returns of such a journal as this. You speak of 20,000 twopences; at trade rates 20,000 *pence* would be very much nearer the mark. These are sordid considerations, are they not? why, certainly; and the thought of daily meals is an animal thought, is it not? Try raising your soul entirely above this animal thought for a week or two, and then give us your ideas about KNOWLEDGE.—UNITAS. Yes; the vibrating periods of the different rays of the spectrum have been accurately determined. The information will be found in any treatise on the spectrum. There are 458 billions of undulations per second in the extreme red, 727 billions in the extreme violet.—NEMO. Those stories of marvellous eyesight have often been found to be untrue. I should imagine Brussels paper of 1875 or 1876, from which you send an extract, appeared in the great gooseberry season. Let telescopists judge:—It tells us that Jean Trubell could see the four moons of Jupiter and the two rings of Saturn. Not a true bill, you may be sure.—J. GOTTFRIED. The Magic Square, combined with the Knight's Tour, is good in its way; but we cannot find room for it. We want a plan for getting a quart into a pint pot; it always beats us.—SIMPLEX. Many thanks.—W. W. FAWCUS. Your theory of lightning hardly consistent with the production of the electric spark in perfectly dry air.—G. B. FRASER. I ought long since to have thanked you for the very interesting book by Mr. Lindsay, which you have kindly lent me. It is full of matter of great value to me.—J. E. J. Thanks for note on change of colour of hair in case of one of the survivors of Isandula.—THOUGHTFUL. Will find space if possible.—CORBEAU. Yes; La Fontaine's familiar fable makes the crow act rather foolishly. In Chaucer's Nun's Priest's Tale, it is Chanticleer who is beguiled by Reynard's flattery, and then Reynard is beguiled in turn. But this is a lesson in sense, not in science,—to show us

> What it is for to be reckëless,
> And negligent, and trust on flattery;

and also that he is

> Indiscreet of governance,
> That jangleth when that he should hold his peace.

Æsop's fable of the "Crow and the Pitcher" might be used the other way, if fables counted.—EUCLID. Thanks for account of fireball on May 4 at 9.30 p m. If the same object was seen by others far away from your station (Bolton), and a good account of the apparent path can be given, the observation may be useful in determining the real path of the meteor in our air; otherwise not.—JAS. SMITH. There is no rigid arch, and practically no arch at all, the curvature of the earth's superficial strata being so slight. If the Himalayas were twenty miles high there would be some reason for wondering at their stability. To all intents and purposes the pressures existing within the earth are such as would result if the whole earth were fluid. The cohesion even of a granite stratum, of whatever thickness, small or great, does not prevent the whole stratum from pressing downwards, and communicating downwards the pressure it receives from above, with practically unchanged effect. Sir W. Thomson's argument is, in fact, just this, that there is no solid shell with fluid nucleus relieved by rigidity of such shell from external pressure, but that the earth's whole globe is continuous, with no freed fluid mass within. If you consider that, were the whole earth water, an ice mountain of any height (consistent with the rigidity of ice) could rear itself above that fluid surface, sustained by fluid pressures alone, you will see how little force there is in the argument you derive from the Himalayas. E. S. INSULL, points out that in the Pharmacy Act, 1868, preparations of morphine, as well as opium and all preparations of opium are specifically mentioned as poisons.—F. T. JONES. We would print your thoughtfully-written letter in full, were there space; but there is not. The answer to your difficulty is simply, that within the period covered by astronomical observation the day has altered so slightly that, until quite recently, it was regarded as constant; the slight change would not affect the appreciably unchanging length of the year. You refer, I notice, to what I have stated as the result of the investigations of others as if it were my own special statement.—J. HARGREAVE. You ask in what sense the words "moment of gravitation" as used by Dr. Siemens in his letter are incorrect. In this—the word "moment," in all mechanical questions, means motion, not the force causing motion; Dr. Siemens applies it to mean the moving force on a mass of gaseous matter at the solar poles; a moving force is measured by the "momentum" or "moment," or quantity of motion it can generate, but to the mathematician, calling a moving force *moment* is as incorrect as it would be to call a printing-machine a printed volume.—SOME MORE FELLOWS. Why, certainly; so I supposed.—A. JONES.—To deal with your problem, we must know the coefficient of elasticity between billiard-ball and cushion, and coefficient of friction between ball and baize.—ELECTRON. Others think a great deal too much space given to that subject.—E. L. H. Letter duly received, and shall appear.—E. M. O. Nay, but the transit will soon be over. Comets come and go all the time.—H. A. B. Sheet lightning is quite distinct from forked; the electricity is of small tension, and there is no thunder. A flash of lightning being a discharge between cloud and earth, or between cloud and cloud, can never be said to be dispersed in air.—F. T. PIGGOTT. Paper on Foresights in type; thanks. ALEX. SMITH. Surely a note to Mr. D. Bogue, publisher of the now defunct *Popular Science Review*, would bring you what you require.—PECCAVI. *Peccavisti*—in this respect, that the ink you have used has become so smeared that I cannot read all your questions. (1) A ray of light appears to travel onwards without measurable diminution within measurable distances. (2) Do not know experimentally whether ascending air bubble in water casts a shadow, though rarer than the water. Theoretically it should, as a light ray will not pass out of water into air at small angles. (3) Stanley's book on Fluids, reviewed in KNOWLEDGE a few weeks back, will help you as to the other questions, so far as I can guess their purport from the few unobliterated words.—F. W. CORY, F.M.S. I try a new arrangement for weather this week. You say, in passing, that many readers probably "usurp an Englishman's prerogative of grumbling—very often at nothing." I would not mind *that* so much; what troubles me is, that some will grumble at everything. This does not apply to your letter, though you *do* describe the weather reports as "simply abominable." I think you are about right; hence the change. Possibly, with the first number of Volume II., which opens in June, an improvement on this may be tried. Of course, there are many difficulties.—R. M. HANDS. The passage in the Pyramid points too far from the Pole to aim at our present Pole Star, which is much nearer the Pole than Alpha Draconis ever was or ever could be.—BOYD MOSS. Are you not thinking of a screw nearly "home," and overlooking the fact that Sir E. Beckett's device is to help chiefly when the screw is "far from home?" He is no theoriser about such matters, but eminently practical. I am sorry I overlooked your astronomical query. Will you kindly repeat it?—A. J. I. Thanks for story of omnibus horse stopping when lady hailed unobservant conductor. It certainly suggests intelligence and observation.—S. S. An intra-mercurial planet, if such exists, must be very much smaller than Mercury, and being farther off when in transit, would seem smaller still. It can readily be shown that the largest intra-mercurial planet which can exist consistently with the observed constant absence of any naked-eye object during total eclipses, must be utterly invisible when in transit (to unaided eyesight).—E. G. I do not know of any complete tables of logarithms giving results to ten or twelve digits.—THOMAS LYONS. Pray do not think us uncourteous in omitting your query; it is quite true that the term "knowledge" is very wide, but the journal KNOWLEDGE is not very large, and something has to give way when an attempt is made to make the less enclose the greater. "Five of Clubs" and "Mephisto" will be proud of your favourable opinion of their columns.—SHEFFIELD. Thanks for your kindly letter. We feel that, as you say, it would be unfair to make a change in the direction of "enlargement with increased price."—SELENIAL. The keepers of second-hand book-stalls would be able to tell you where to get old copies of the examination questions for matriculation at London. I do not know.—FUSIYAMA. Alas, our readers "will not away with" more magic squares! How can your lotus-leaf problem be dealt with, without some data as to lotus-leaves?—J. LUTHER HAYNES. I do not know in what paper you could get weekly information of the rainfall in Sarthe and Loire.—J. F. Description of microphone in hand, as promised; but want of space troubles us at present. "Electron" and others want more electricity, and scarcely any astronomy; "J. Hemming" and others howl against "Blow-pipe Chemistry," and want more natural history; and so on all down the scientific subjects.—J. GROSVENOR DAWE. An index to Vol. I. will be issued immediately.

[About two pages of "Answers" have been unavoidably held over]

Our Mathematical Column.

INVERSE PROBABILITIES.

THE formulas we have obtained show that in a set of drawings or trials of any sort some results are more probable than others. For instance, if we took a set of twelve balls out of a bag of 4,000,000 balls, of four colours equally divided, we should be more likely to draw three of each kind contained in the bag, than to draw one of one specified kind, two of another kind, also specified, four of another specified kind, and five of the remaining class, but less likely to draw three of each kind, than one of one kind, two of another, four of another, and five of the remaining class, *without* specification.* And so in a variety of cases we can compare the chances of different results when the antecedent conditions are known. But it is clear that this power of partial forecasting implies a power of inferring antecedent conditions from observed results. We may now enter upon this interesting department of our subject. In so doing, we are preparing to discuss that application of the laws of probability which is chiefly to be considered in discussing the results of observation and experiment. But it is well to premise that the two departments of the science of probability are most intimately associated together, insomuch that one cannot well be studied without the other. This will appear, indeed, at the very beginning of our discussion of indirect probabilities.

We know from the laws of direct probability that if there are in a bag ten balls, three white and seven black, the chance of drawing a white ball is $\frac{3}{10}$, and the chance of drawing a black ball is $\frac{7}{10}$. Now if we suppose the ten balls all alike in colour (say all white), but three of them bearing a mark not discernible by the drawer (who, however, is supposed to be aware that three *are* marked) it is clear that when he has drawn a ball, although he cannot tell whether it is one of the three marked balls, he knows that the probability of his having drawn a marked ball is $\frac{3}{10}$. Now suppose these ten balls put into a bag with twelve others, these others being black; and that a white ball is drawn. In this case, as in the former, the drawer knows that the probability of the white ball being one of the marked three is $\frac{3}{10}$. The addition of the twelve black balls diminishes the chance of drawing one of the marked three, but when the fact is known that a white ball has been drawn, the chance that this ball is one of the marked three is obviously not a whit affected by the addition of the black balls.

Now, suppose that instead of twenty-two balls in one bag there are two bags, each containing eleven balls—in one bag the three marked white balls and eight black ones; in the other seven white and four black balls. If a bag is to be selected at random and a ball to be drawn at random from the bag thus selected, it will be obvious that the chance of drawing one of the marked balls is precisely the same in this case as in the former; for the chance of selecting the right bag of eleven balls is precisely the same as the chance that one of the eleven balls now in the bag would be drawn from the original twenty-two, that is, is *one-half*. Otherwise, the chance of drawing a marked ball *would* be affected by separating the twenty-two balls into two sets. For instance, if the three marked balls were put into one bag, and the remaining nineteen into another, it is clear that the chance of drawing one of the marked balls would be one-half instead of $\frac{3}{22}$. But the two bags containing the same number of balls,† the chance of drawing one of the marked balls is unchanged.

But we have seen that when a white ball has been drawn from the set of 22 (all in one bag), the probability that it is one of the marked balls is $\frac{3}{10}$. Hence, when a white ball has been drawn from one of the two bags of eleven balls the chances that this ball is one of the marked balls—in other words, the chance that it has come from the bag into which the marked balls were all placed—is still $\frac{3}{10}$.

Now the marking was only a device for distinguishing certain of the white balls from the others; and in the case where the balls are put into separate bags the three marked balls are in effect distinguished by being put in a different bag. So that we need no longer imagine any marking; and may thus present the conclusion we have arrived at:—If there are two bags, one containing eight black and three white balls, the other containing four black and seven white balls, then if a bag is selected at random and a ball taken at random from this bag is white, the probability that the bag containing three white balls was selected is $\frac{3}{10}$.

And by following the method whereby this special result was obtained, it is easily seen that the following general law can be deduced:—If there are in each of two bags p balls in all, q of the balls in one bag being white, and r of those in the other; then if a bag is selected at random and a ball drawn at random from this bag is white, the probability that the bag containing q white balls was selected is $\frac{q}{r+q}$. Of course, the probability that the other bag was selected is $\frac{r}{r+q}$. It will be observed that p does not appear in either result.

Now take the case where the bags do not contain the same number of balls. Suppose one bag contains eight balls, three of which are white and five black, and the other twelve balls, seven of which are white and five black; and supposing a white ball drawn, let us inquire what is the probability that it came from the former bag?

Here we can obviously reduce the problem to the former case by changing the number of balls in the two bags without modifying the proportion of black and white balls. Thus, taking 24, the least common multiple of 8 and 12, we see that the first bag may be replaced by one containing 24 balls, of which 9 are white; while the second bag can be replaced by one containing 24 balls, of which 14 are white. The chance of drawing a white ball from one or other bag is in no way modified by these changes, and consequently the inferences to be deduced when a white ball has been drawn are not modified. But the numbers being now equal, we learn from what was shown in the former case, that if a white ball is drawn the probability is $\frac{9}{9+14}$ or $\frac{9}{23}$ that it was taken from the first bag.

---

* As examples remove much of the seeming mystery of general laws, I will compare these three chances together. The chance of any particular result is the same appreciably as though a ball were drawn at random and returned, the operation being repeated twelve times; and this chance, again, is exactly the same as though the bag contained only 1 red, 1 white, 1 black, and 1 green ball. So that the p, q, &c., of our formula are each equal to unity—the total number of trials is 12, and the first probability we require relates to the drawing of each ball three times. The value of this probability is, therefore—

$$\frac{\underline{|12}}{\underline{|3}\ \underline{|3}\ \underline{|3}\ \underline{|3}} \cdot \frac{1^3.1^3.1^3.1^3}{4^{12}} \qquad \text{(i)}$$

(I write out $1^3.1^3$, &c., in full, to show the connection between the expression and our formulas.) Now, the second probability we require relates to the drawing of a definite number of each kind, specifying what kind is to be drawn once, twice, &c. If the chance were required that 1 red, 2 white, 4 black, and 5 green balls would be drawn, the expression for the probability would be—

$$\frac{\underline{|12}}{\underline{|1}\ \underline{|2}\ \underline{|4}\ \underline{|5}} \cdot \frac{1^1.1^2.1^4.1^5}{4^{12}} \qquad \text{(ii)}$$

And we should get the same probability, whatever the specifications might be. Further, since there are $\underline{|4}$, that is 1.2.3.4 different specifications possible, the third probability which relates to the drawing of 1, 2, 4, and 5 of different kinds, without specifying which kind is to appear once, twice, four times, and five times, is equal to

$$\underline{|4} \cdot \frac{\underline{|12}}{\underline{|1}\ \underline{|2}\ \underline{|4}\ \underline{|5}} \cdot \frac{1^1.1^2.1^4.1^5}{4^{12}} \qquad \text{(iii.)}\ .$$

Now, by striking out common factors, it is readily seen that the expressions (i), (ii), and (iii) are to each other as $\frac{1}{3\ .\ \underline{|3}\ .\ \underline{|3}}$, $\frac{1}{\underline{|4}.4.5}$ and $\frac{1}{4.5}$; or, as $\frac{1}{108}$ to $\frac{1}{480}$ to $\frac{1}{20}$; so that (iii) is the greatest, and (ii) the least, as was to be shown.

† The reader should most carefully note the point of the reasoning here. If we put an equal number of balls into each bag, we have not modified the probability that the ball actually drawn will belong to one set or to the other equal set; the chances were equal before the separation, and they remain equal after the separation. But if we put into one bag a smaller number of balls than we put into the other, we *have* modified the chance that the ball actually drawn will belong to the larger or to the smaller set; the chances were not equal before the separation, but they *are* equal after it.

Now let us apply this method to a more general case. Suppose one bag contains p balls, of which q are white, and that another bag contains p' balls, of which q' are white; a white ball is drawn—what is the chance that it came from the former bag?

Here we take $p\,p'$, the common multiple of p and p, and replace the first bag by one containing pp' balls, of which $p'q$ are white; the second by a pp' balls of which pq' are white. The numbers are now equal, and, therefore, our former rule gives $\frac{p'q}{p'q+p'q}$, as the chance that the drawn white ball came from the first bag; and $\frac{pq'}{p'q+pq'}$ as the chance that this ball came from the second bag.

If we divide the numerator and denominator of these expressions by pp' we obtain expressions for these chances which are readily interpretable into a law for all such cases. The former expression becomes

$$\frac{\frac{q}{p}}{\frac{q}{p}+\frac{q'}{p}},\text{ the latter becomes }\frac{\frac{q'}{p'}}{\frac{q}{p}+\frac{q'}{p'}}$$

and since $\frac{q}{p}$ is the probability of drawing a white ball from the first bag if this bag is selected, while $\frac{q'}{p'}$ is the probability of drawing a white ball from the second bag if selected, we have this general law:—

If the chance of drawing a white ball from first bag is C_1 and the chance of drawing a white ball from the second is C_2, then if a white ball is drawn, the chance that it came from the first bag is $\frac{C_1}{C_1+C_2}$, the chance that it came from the second is $\frac{C_2}{C_1+C_2}$. But the bags of balls are merely illustrative, and we can obviously proceed at once to this general law:—

If there are two hypotheses equally likely, and one of which *must* be true, and on the first hypothesis the chance of a certain event is C_1, while on the second hypothesis the chance of the event is C_2, then, if the event happen, the probability that the first hypothesis is the true one is $\frac{C_1}{C_1+C_2}$, and the probability that the second hypothesis is the true one is $\frac{C_2}{C_1+C_2}$.

The importance of this formula will be more readily understood when it is applied to illustrative cases, to be considered in our next number.

PROBLEMS.

Problem 43.—A tapering beam is 30 ft. long. At a distance of 10 ft. from the thick end it is in equilibrium. The fulcrum is shifted 2 ft. nearer the small end, and the beam is then in equilibrium when a weight of 60 lb. has been suspended to the thin end. Find the weight of the beam.—W. D. B.

Problem 44.—There are two drums; the diameter of the larger is, say, 3 ft.; that of the smaller is, say, 2 ft.; the distance from centres is, say, 10 ft.; required the exact length of belting necessary for them.—W. D. B.

---

[40].—The equation belongs to a well-known class. It may be depressed by putting p for $\frac{d\theta}{dt}$, when it becomes

$$\frac{dp}{dt}+ap^2=-b\theta,$$

$$\text{or, since }\frac{d\,\cdot}{dt}=\frac{d\theta}{dt}\cdot\frac{dp}{d\theta}=p\frac{dp}{d\theta}=\frac{1}{2}\frac{d(p^2)}{d\theta},$$

substituting and multiplying by 2 we get $\frac{d(p^2)}{d\theta}+2ap^2=-2b\theta$, a linear equation of the first order and first degree.

whence $$p^2=\frac{1}{e^{2a\theta}}\left\{C-\frac{b}{a}e^{2a\theta}\left(\theta-\frac{1}{2a}\right)\right\}$$

Therefore $$\frac{1}{p}=\frac{dt}{d\theta}=\pm\frac{e^{a\theta}}{\sqrt{C-\frac{b}{a}e^{2a\theta}\left(\theta-\frac{1}{2a}\right)}}$$

an expression which cannot be integrated in a finite series of terms.—J. R. C.

Our Whist Column.

BY "FIVE OF CLUBS."

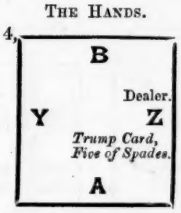
A GAME FOR STUDY.

THE following hands are given by Clay to illustrate a case—or, rather, a class of cases—where it is necessary to disregard rule:—

THE HANDS.

A.
Spades—Q, Kn, 10, 4, 3, 2.
Hearts—5, 3.
Clubs—Q, 9, 8, 3.
Diamonds—9.

B.
Spades—A, K, 6.
Hearts—K, Kn, 2, 4.
Clubs—5, 2.
Diamonds—K, Kn, 3, 2.



Y.
Spades—8, 7.
Hearts—9, 7, 6.
Clubs—A, K, Kn, 10.
Diamonds—10, 7, 6, 5.

Z.
Spades—9, 5.
Hearts—A, Q, 10, 8.
Clubs—7, 6, 4.
Diamonds—A, Q, 8, 4.

Score:—
A, *B*, = 4.
Y, *Z*, = 4.

SINGULAR HAND AND SINGULAR ILL-FORTUNE; YARBOROUGHS.—The following is said to be a remarkable hand of cards dealt to the Duke of Cumberland, as he was playing at Whist at the rooms at Bath, by which he lost a wager of £20,000, not winning one trick. The Duke's hand consisted of King, Knave, nine and seven of trumps (clubs); Ace and King of diamonds; Ace, King, Queen, and Knave of hearts; and Ace, King, and Queen of spades. The Duke leads a small trump. Right hand of the Duke five small trumps, all the other cards hearts and spades. Left hand of the Duke Ace, Queen, ten and eight of trumps; Queen, Knave, ten, nine, eight, seven, six, five, and four of diamonds. This hand, after winning the first trick, leads a diamond. The Duke's partner's hand all insignificant cards." The above is extracted from the *Kaleidoscope* of Feb. 4, 1823. It may interest the readers of your "Whist Column." Was the Duke's lead judicious? In January last my partner had a Yarborough hand dealt, and many years ago I was at a party where one was dealt. I imagine few people came across *two* such.—R. G.

[In "Cœlebs on Whist," there is a somewhat similar case, only instead of failing to make a trick, the holder of the strong hand loses five by tricks. Cœlebs says, a lead of trumps from such a hand is wrong. But ninety-nine players out of a hundred would lead trumps; and in my opinion the hundredth would lead wrongly. We must not judge by the event in such cases. The whist-player can only play according to probabilities; and the chances are in favour of the trump-lead turning out well. It is far more likely, for instance, that, if a Heart is led (the Hearts suit being already established, be it noticed), the adversary will ruff it, and perhaps establish a cross ruff, than that the cards would be so singularly distributed in the other hands, as they were in this case. I suppose, for example, that the cards had lain thus:—The Duke's hand, as above (call it *A*'s hand); *B*'s, small cards, no trumps; *Y*'s hand, the four trumps named above, no spades, four hearts and diamonds; *Z*'s hand, five remaining trumps, no hearts, three spades and diamonds. Then, if *A* leads from his long suit, he loses two by tricks, which, with such a hand, and a plain suit lead, is singular ill-fortune.

Yarboroughs are more common than our correspondent supposes. Within the last eight months we have come across three. The editor of the *Westminster Papers* mentions two as occurring to himself at the same sitting.—FIVE OF CLUBS.

Our Chess Column.

SOLUTIONS.

PROBLEM No. 26, p. 461.

1. Q to Ktsq	Q to Q6 or	1.	P takes KtP
2. R to QR2	K to Kt3 (*a*)	2. Kt to Kt7(ch)	K to R5
3. R to R6	Any move	3. R to R2 (mate)	
4. Kt to Kt7 (mate)			

(*a*) If 2. Q takes Q. 3. Kt to Kt7(ch). 3. K to Kt3. 4. R to R6(mate).

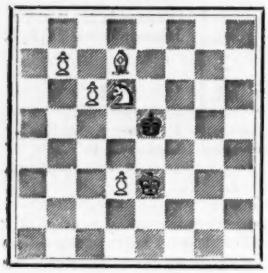
PROBLEM No. 39, p. 580.

1. Kt to Kt6(ch)	BP takes Kt or	1.	RP takes Kt
2. Q to B8(ch)	B to Ktsq	2. Q to R4(ch)	K to Ktsq
3. Q takes P(ch)	K takes Q	3. Kt to Q7(mate)	
4. B to B6(mate)			

End games by Leonard P. Rees, p. 597.

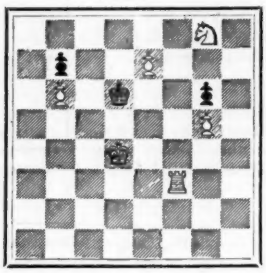
No. 40.		No. 41.	
1. Q takes R(ch)	K takes Q	1. R to Q4(ch)	K to R4
2. Kt takes P(ch)	K to Ktsq	2. R to R4(ch)	K takes R
3. Kt to B6(ch)	K moves	3. Kt to B5(ch) and wins	
4. R to K8(mate)		if 2. K to Kt3	
		3. R to Kt4(ch) wins	

PROBLEM No. 43, by J. Licence.
BLACK.



WHITE.
White to play and mate in three moves.

PROBLEM No. 44, by J. Licence.
BLACK.



WHITE.
White to play and mate in two moves.

VIENNA INTERNATIONAL TOURNAMENT.

On Saturday night, the 27th ult., the 15th round was completed. The score stood as follows :—

Mackenzie	10½	Noa	8½	Fleissig	6
Steinitz	10	Schwarz	8½	Tschigorin	6
Winawer.....	10	Wittek	8	Paulsen	5½
Blackburne.....	9½	Hruby	7½	Weiss	5½
Mason	9	Zukertort	7½	Meitner	5
Englisch	8½	Bird	6	Ware	3½

Of special importance was the encounter between Blackburne and Zukertort, which took place on May 24. Blackburne won. On the same day Mackenzie lost his first game (out of eleven) to Schwarz, an experienced Hungarian player. In the course of the week, Blackburne, however, lost two games—one against Paulsen, the other against Noa, also an Hungarian.

Steinitz showed great improvement, and out of the six games played in the week he won five and drew one (Mason). We are sorry to hear that Zukertort is indisposed, and owing to his bad state of health he is doing badly. Out of the six games played he has lost four and won two. Mason won two, lost one, and drew three (Blackburne, Steinitz, Fleissig).

[*By Telegram.*] Vienna, Tuesday night.

Score of English team :—Mackenzie, 11½ (beat Meitner); Steinitz, 11 (beat Schwarz); Blackburne, probably 10 (at the time of wiring the score, his game with Englisch assumed a drawn aspect); Mason, 10 (beat Weiss); Zukertort, 8½ (beat Bird).

REVIEW.

A Complete Guide to the Game of Chess. By H. F. L MEYER.

"Chess is such a noble game,
How it does the soul inflame!"*

"There are moments in our lives when we have nothing particular to do"; in these moments we might peruse the above book, which is a novelty of its kind. It contains a vast amount of useful information for a beginner, hitherto not contained in any other book. The book may be called a "Chess Dictionary," as it deals with every item connected with Chess. For instance, speaking about the board, the author says, "The best boards and men are those made of hard wood or metal, and the latter should be made so strong that in case they should drop from the table they would not be liable to break!!" In dealing with the laws of Chess, he says: "Any player wilfully disturbing his adversary shall be admonished." (We quite agree with that.) Problems are very minutely dealt with; there are no less than 110 problems given. The author says, "A good four-mover might take as much as five years to construct." Now, if we look at the prodigious array of good four movers composed by an eminent German problemist, we conclude his age must be something approaching to that of Methuselah.

The game department is also dealt with in great detail, and there are numerous illustrative games. But also in this department—as indeed, throughout the whole book—we meet the remarkable and utter. We find a game played by the author, "Mr. H. F. L. Meyer playing *blindfold, looking* at the same time *at pictures*, and *conversing* with *two* bystanders." But of far more importance than these little peculiarities of the author, is the fact that he has adopted some fad of his own, in the shape of a new annotation, which we regard as a joke perpetrated at the publisher's cost. People will not go out of their way to study the author's notation. We take this opportunity of expressing our most decided opinion that the English notation is far superior, and more pleasant to follow, than the German system, aggravated by the author's improvements on it.

* What is inflammation of the soul?

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Leonard P. Rees.—Thanks for your generous offer; but tourneys are not included in our Chess Programme for the present. End-games welcome.

Francis J. Drake.—Solutions of Nos. 39, 40, 41, and 42 correct.

Senex Solitarius.—Solution of No. 38 correct.

J. B., Queenstown.—Solution of Nos. 39 and 40 correct; also Nos. 41 and 42. Correct solution of No. 42 received from G. W., Alfred B. Palmer, H. A. N., Moleque; 40, 41, 42 of Muzio; 38 of Dr. H.; 40 and 41 of Red Ink; 39, 40, and 41 of J. Napier.

Correct.—If 1. Kt to B2(ch), 1. K to B4, and there is no mate. Solutions are usually given about three weeks after publication of problems.

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